

Virginia Water Resources Research Center

Annual Technical Report

FY 2000

Introduction

The Virginia Water Resources Research Center (VWRRC) is both a federally authorized program within the U.S. Department of Interior under the U.S. Geological Survey and a state agency under the Code of Virginia administered by the Research Division at Virginia Tech.

Virginia is typical of other urbanizing Eastern states. Virginia continues to struggle with water quantity issues and the need to reduce conflicts over urban water supply expansion projects. Also, water quality issues dominate the attention of state and local leaders. Virginia's water quality concerns are motivated by the impaired water listing process and the TMDL program mandated under section 303(d) of the Clean Water Act. The VWRRC will continue to support and encourage research on these issues and timely dissemination of relevant information to decision makers in state, local and federal agencies, members of the Virginia General Assembly, academia, and the citizens of Virginia. Activities and programs of the VWRRC are reflected in its mission statement: The VWRRC will advance the Commonwealth's and its universities' mission by:

1. Encouraging studies of solutions to water resource problems.
2. Facilitating the water resources education of university students.
3. Enhancing the transfer of water science, policy, and management information to public and private decision makers.

The mission statement was developed in the fall of 1995. In developing the mission statement, the VWRRC history and legislative mandates were considered, but realities of future budget prospects were also recognized. The VWRRC could no longer rely on base grant funding to directly support programs of research and technology transfer. Instead, the VWRRC would have to seek project specific funding in collaboration with university faculty, and assume a leadership role and act as a facilitator rather than as a funding source. Toward this end, the VWRRC would increase its responsiveness to the needs of the Commonwealth and regional decision makers. The use of 104 funds is critical to the management of the VWRRC. The availability of 104 funds has been instrumental in increasing the university (Virginia Tech) and state commitment to the programs of the VWRRC.

During the FY 2000 reporting period, the VWRRC used its 104 funds to support publishing of its newsletter (Water Central), to further develop and update its Website, and to support internal operations. In summary, the 104 funds were dedicated to the outreach function. Supplemental funds added to the base grant by other federal agencies were used to conduct studies of the wetland permitting program of the Army Corps of Engineers. The VWRRC also was able to support the USGS internship program, and other research, educations and outreach programs. During the reporting period, the VWRRC used its state allocation to fund 3 state-wide competitive grants (up to \$25,000/year) and several seed grants (up to \$5,000). The VWRRC also provided, on a competitive basis, several undergraduate research fellowships, summer internships and one graduate fellowship. The VWRRC organized a national symposium entitled "Advances on Water and Land Monitoring Research for Management of Water Resources".

Research Program

Major research activities (funded through programs other than 104 funds) undertaken by the VWRRC staff and affiliated faculty during the reporting year are:

1. Regional Water Supply Management
2. Developing TMDL Reports for Impaired Stream Segments
3. Capacity Development for Small Water Systems
4. Watershed Assessment and Instrumentation

During the reporting period, the VWRRC used its state allocation to fund 3 state-wide competitive grants (up to \$25,000/year) and several seed grants (up to \$5,000). Publication and other information related to the VWRRC seed grants and competitive grants are presented later. Below is a brief report on a USGS regional grant that was completed this year.

Basic Information

Title:	Optimal Design-Rehabilitation Strategies for Reliable Water Distribution Systems
Project Number:	1434-HQ-96-GR-02703
Start Date:	9/1/1997
End Date:	2/28/2001
Research Category:	Engineering
Focus Category:	Water Supply, Water Use, None
Descriptors:	water distribution, optimization
Lead Institute:	Virginia Polytechnic Institute and State University
Principal Investigators:	G V Loganathan, G V Loganathan

Publication

1. Sherali, H.D., Totlani, R., and Loganathan, G.V., Enhanced Lower Bounds for the Global Optimization of Water Distribution Networks, *Water Resources Research*, Vol. 34, No. 7, 1998, 1831-1841. Loganathan, G.V., Park, S., and H.D. Sherali, A Threshold Break Rate for Pipeline Replacement in Water Distribution Systems, *J. of Water Resources Planning and Management*, ASCE., 2001. (to appear) Sherali, H.D., Subramanian, S., and Loganathan, G.V., Effective Relaxations and Partitioning Schemes for Solving Water Distribution Network Design Problems to Global Optimality, *Journal of Global Optimization*, Vol. 19, pp. 1-26, 2001.
2. Subramanian, S., Optimization Models and Analysis of Routing, Location, Distribution, and Design Problems on Networks, Doctoral Dissertation, Virginia Polytechnic Institute and State University, 1999. Park, S., An Optimal Pipeline Replacement Scheduling Model for Water Distribution Systems, Doctoral Dissertation, Virginia Polytechnic Institute and State University, 2000.
3. Park, S., and Loganathan, G.V., An Optimal Pipe Rehabilitation Scheduling Model for Water Distribution Systems, ICHE-2000, 4th International Conference on Hydrosience and Engineering, Seoul, Korea, September 26-29, 2000. Loganathan, G.V., Park, S., Agbenowosi, N.,

and Sherali, H.D., A Threshold Break Rate for Scheduling Optimal Pipeline Replacement, World Water and Environmental Resources Congress, ASCE, Orlando, FL, May 20-24, 2001. Sherali, H.D., Subramanian, S, and Loganathan, G.V., Sequential Polyhedral Relaxations for Solving Water Distribution Network Design Problems to Global Optimality, XIII International Conference on Computational Methods in Water Resources, University of Calgary, Alberta, Canada, June 25-29, 2000.

Project Synopsis

The main contribution of this research consists of the development of new methodologies for optimal replacement of an individual water main and global optimal design of an expanding water system. Because the proposed optimal threshold break rate is strictly analytical and provides an economically sustainable critical break rate, it should be of help in prioritizing failure prone water mains for replacement. Also, the connection to the functions of reliability theory such as the rate of occurrence of failure (ROCOF) and the hazard rate are established. The design aids in the form graphs (Figure 3.2 and 3.3) permit engineers to understand the system-wide failure pattern of pipes better. The utility of the parametric form of the ROCOF function, the Weibull proportional intensity function capable of incorporating environmental variables is illustrated; the procedure also accommodates time-truncated data and full failure history is not needed.

The global optimal design formulation presented in this report provides a holistic approach for modeling an expanding pipe network. As opposed to the techniques that search for improving local optima, the present formulation provides theoretical limits and is capable of reaching the global optimum. The implementation of the procedures is illustrated via examples. In combination, the critical threshold break rate allows for progressive replacement of pipes and the optimal design scheme permits suitable selection of pipe diameters.

For full report contact: Dr. G. V. Loganathan, Civil and Environmental Engineering Department, Virginia Tech (E-mail: gvlogan@vt.edu).

Information Transfer Program

During the FY 2000 reporting period, the Virginia Water Resources Research Center used its section 104 program to support the publishing of its newsletter (Water Central). First issue of Water Central was published in June 1998. During the reporting period 4 issues were published (April 2000, Summer 2000, November 2000, and January 2001). The hard copy of the Water Central is distributed to 2400 subscribers free of charge and 255 individuals receive electronic copies. Current and back issues of the Water Central are posted on the VWRRC website and can be located at:

<http://www.vwrcc.vt.edu/central/virginia.htm>

Since 1998, the VWRRC displays on its web-based daily news posting on water issues. Every day, support staff browses through regional newspapers, extracts water related items and posts on the VWRRC website. The web-based daily news gathers water-related articles in one location on a daily basis and it is a very popular feature of the VWRRC website. Web visitors include state and local agency personnel and interested citizens. This feature of the website can be located at:

<http://www.vwrcc.vt.edu/news/daily.htm>

During the reporting period, the VWRRC sponsored the National Symposium "Advances in Land and Water Monitoring Research for Management of Water Resources" in Roanoke, Virginia as the Virginia Water Research Symposium 2000. More than 200 people from academia, federal and state agencies, and consulting firms attended the symposium. Proceedings of the symposium are available in CD disks and also can be downloaded as pdf file from:

<http://www.vwrcc.vt.edu/publications/recent.htm>

Basic Information

Title:	Water Central - VWRRC Newsletter
Start Date:	3/1/2000
End Date:	2/28/2001
Descriptors:	Newsletter
Lead Institute:	Virginia Water Resources Research Center
Principal Investigators:	Leonard Shabman

Publication

1. Alan Raflo (Editor) Water Central April 2000. Water Central Summer 2000. Water Central November 2000. Water Central January 2001.

Basic Information

Title:	Virginia Water Research Symposium 2000
Start Date:	3/1/2000
End Date:	2/28/2001
Descriptors:	Symposium
Lead Institute:	Virginia Water Resources Research Center
Principal Investigators:	Leonard Shabman

Publication

1. Younos T. (Editor). 2000. Advances in Land and Water Monitoring Research for Management of Water Resources. CD-Proceedings, 282 pp. Virginia Water Resources Research Center, October 2000.

Basic Information

Title:	Daily Web-Based News
Start Date:	3/1/2000
End Date:	2/28/2001
Descriptors:	Newsletter
Lead Institute:	Virginia Water Resources Research Center
Principal Investigators:	Leonard Shabman, Leonard Shabman

Publication

USGS Summer Intern Program

Student Support

Student Support					
Category	Section 104 Base Grant	Section 104 RCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	0	0	0	13	13
Masters	0	0	0	9	9
Ph.D.	0	0	0	4	4
Post-Doc.	0	0	0	0	0
Total	0	0	0	26	26

Notable Awards and Achievements

None

Publications from Prior Projects

1. Dietrich, A.M., D.L. Gallagher, and K.A. Klawiter. 2001. Inputs of Copper-Based Crop Protectants to Coastal Creeks From Plasticulture Runoff. *Jour. AWRA*, 37(2):281-294. Seaton, W.J., and Burbey T.J., 2000 Aquifer characterization in the Blue Ridge Physiographic Province using resistivity profiling and borehole geophysics: *Jour. of Environ. and Eng. Geophysics*, v. 5, no. 3, p. 45-58. Leonard Shabman and Kurt Stephenson. 2000. Environmental Valuation and Its Economic Critics *Journal of Water Resources Planning and Management*, November/Dec 2000, v. 126. No. 6, pps. 382-388. (Award for best theoretical paper in the journal in 2000). Eric P. Smith, Keying Ye, Chris Hughes and Leonard Shabman, Assessing Violations of Water Quality Standards Under Section 303 (d) of the Clean Water Act, *Environmental Science and Technology*, v. 35. No. 3. 2001, pps 606 612. K. Stephenson and L. Shabman, The Role of Non-market Valuation in Hydropower Relicensing: An Application of a Pattern Modeling Approach, *Journal of Economic Issues*, June , 2001, in press. Leonard Shabman, Laura Zepp, Dennis King, and Lisa Wainger, Opportunities and Barriers to Private Landowners Participation in the Sale of Carbon Sequestration Credits Produced by Reforesting Frequently Flooded Agricultural Land: A Case Study in the Mississippi Delta, *American Journal of Alternative Agriculture*, in press Younos, T., F.W. Kaurish, T. Brown, and R. de Leon. 2001. Determining the Source of Stream Contamination in a Karst-Water System, Southwest Virginia, USA. *Jour. AWRA*, 37(2):327-334.
2. Groover, G.E. 2000. Financial Performance of Pastured-Based Dairies: A Virginia Case Study. Ph.D. Dissertation, Virginia Tech. Park, S. 2000. An Optimal Pipe Replacement Scheduling Model for Water Distribution Systems. Ph.D. Dissertation, Virginia Tech.
3. Burbey, T.J., and Seaton, W.J., 2000, Evidence for a new hydrogeologic model for the Blue Ridge and Piedmont Provinces: Proceedings of the Virginia Water Research Symposium, Richmond VA, Nov 15-16, 1999, pp. 20-24. Walker, J. and T. Younos. 2000. The Role of Water Resources Institutes in Information Dissemination: Virginia Water Information and Technology Transfer Web Site. The Third Water Information Summit's Conference Papers and Presentations. <http://www.waterweb.org/wis/wis3/pub-paper.ihtml>
4. Walker, J., T. Younos, and A. Raflo. 2001. A Service-Learning Program and Its Role in

Watershed Management. Water Resources Update 119: 42-26.

5. Roggenbuck, J.W., S.C. Haas, T.E. Hall, R.B. Hull. 2001. Motivation, Retention, and Program Recommendations of Save Our Streams Volunteers. VWRRC Special Report SR19-2001.